

## Original Article

## Pediatric Logistic Organ Dysfunction (PELOD) Score as prognosis of multiple organ failure in sepsis

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### Abstract

**Background** Sepsis is an emergency event that often found in pediatric intensive care unit. If this condition is not early detected and promptly treated, severe complications including septic shock and multiple organ failure may result that can end up as death.

**Objective** To discover alternative measurement as a prognosis of multiple organ failure in sepsis.

**Methods** This cross sectional study was conducted in 37 patients diagnosed as sepsis. The age of the patients were 1 month until 13 years and the patients were hospitalized in child health department of R. D. Kandou Hospital during June 2009 – September 2009.

**Result** Bronchopneumonia (18) was the most common infection source, followed by gastroenteritis (11), encephalitis (6) and meningitis (2). The bacteria which is found was *Proteus mirabilis* (5), *Citrobacter difersus* (5), *Staphylococcus aureus* (3), *Escherichia coli* (2) and *Acinetobacter baumannii* (1). There was no significant difference in gender distribution, nutrition status and blood culture between both groups. Laboratory findings and clinical manifestations which included white blood cell (WBC) > 10.000/ $\mu$ L (34), platelet count > 150.000 (27) and body temperature 38°C – 39°C (20). There was a correlation between PELOD score and multiple organ failure ( $P=0.02$ ). A higher PELOD score will increase opportunity to get multiple organ failure. In patient with organ failure more than two, PELOD score 0-10 (9 patients), score 11-20 (7 patients), score 21-30 (8 patients), and score 31-40 (1 patient).

**Conclusion** There was a correlation between PELOD score and multiple organ failure in patient with sepsis. A higher PELOD score will increase opportunity to get multiple organ failure. [Paediatr Indones. 2010;50:226-31].

**Keywords:** PELOD score, sepsis, multiple organ failure.

Sepsis is an emergency event that often found in pediatric intensive care unit. Over five decades with antibiotic use and optimal supportive care, mortality caused by sepsis in child still high.<sup>1,2</sup> Incidence of sepsis was 1-10 per 1000 life birth and mortality between 13-50%. Saez-Lorens<sup>3</sup> performed a retrospective study for 12 years in 815 children who was diagnosed as sepsis, it was found that 171 (21%) belonged to sepsis (21%), 497 severe sepsis (61%) and 147 developed septic shock (18%).<sup>3</sup> In Indonesia, mortality caused by sepsis still very high i.e. 50-70% and if septic shock and multiple organ dysfunction occur, mortality become 80%.<sup>4-5</sup> Diagnosis of sepsis varies; sepsis is usually diagnosed based on clinical criteria which are not fundamentally different between institutions. The American College of Chest Physicians and The Society of Critical Care Medicine make a consensus to make sepsis diagnosis. Infection and sign of systemic inflammatory response syndrome (SIRS), i.e. temperature > 38°C or < 36°C, heart rate > 90 times/minutes or > 2 standard deviation (SD) of age, respiratory rate > 30 times/minutes or > 2 SD of age, PaCO<sub>2</sub> < 32 mmHg, leukocyte count

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$> 15.000/\mu\text{L}$  or  $< 5.000/\mu\text{L}$ , immature cell (stab) more than 10%. Sepsis syndrome (severe sepsis) is sepsis with one of acute mental disorder i.e. irritable, lethargy, semi-coma or coma, hypoxia ( $\text{PaO}_2 < 75$  mmHg), increasing of blood lactate or oliguria ( $< 1$  ml/kgBW/hour).<sup>6</sup>

Pediatric Logistic Organ Dysfunction (PELOD) score is a tool which is used to know severity of organ dysfunction in critically ill child.<sup>7</sup> Score which is given to each organ will increase according the severity of organ dysfunction so PELOD score can use to predict severity organ dysfunction.<sup>7</sup> PELOD score of 20 has a probability of mortality about 50% and the higher of PELOD score the higher probability of mortality in a child (sensitivity 54.5%; specificity 80.9%;  $p < 0.5$ ).<sup>8</sup> PELOD score will increase according to accumulation effect of organ dysfunction and severity of sepsis.<sup>9</sup> Study of organ failure in patients with sepsis using PELOD score is rarely found; this prompted us to study about PELOD score in sepsis and multiple organ failure.

## Methods

### Design, location and time

This cross sectional study was conducted in Pediatric Intensive Care Unit (PICU) at R. D. Kandou Hospital from June 2009 until September 2009.

### Population and sample

We included all children aged 1 month until 13 years diagnosed as sepsis using ACCP/SCCM criteria and hospitalized in pediatric intensive care unit at R.D. Kandou Hospital. We excluded patients with severe malaria, severe malnutrition and severe dehydration. The number of subjects was estimated by using  $\alpha = 0.05$ , and had 80% to detect clinically important correlation coefficient PELOD score and multiple organ failure ( $r = 0.40$ ). The total number of subjects was 37 children.

### Sampling methods

Parents of subjects were asked to sign an informed consent. Data collected included history, physical examination, and laboratory tests. History and

physical examination was done by the investigator at work hour and by resident after work hour which was reexamined by the investigator. Laboratory examination was done by hematologist. Venous blood specimen was examined for hemoglobin, hematocrit, leukocyte, thrombocyte, malaria slide, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), blood urea nitrogen (BUN), creatinine and prothrombin time /INR. Blood specimen taken was 6 ml, 2 ml was stored in ethylene diamine tetraacetic acid (EDTA) tube, 2.5 ml was stored in 3 ml of disposable syringe, and 1.5 ml was stored for blood culture and blood gas analysis using heparinized disposable syringe. Examinations were done in first of 24 hours. Each variable was scored and sum for final score which was called PELOD score. Score was given to Glasgow coma scale, pupil reaction, heart rate, systolic blood pressure, creatinine,  $\text{PaCO}_2$ , leukocyte, thrombocyte, and aspartate transaminase. For PELOD score, we used the highest score for each organ dysfunction. For example, if heart rate was 200 beat/minute (PELOD score 10) and systolic blood pressure was 30 mmHg (PELOD score 20) so the score that was taken is 20.

### Definitions

Sepsis defined as clinical evidence of infection with tachycardia ( $\text{HR} > 2$  SD of age), tachypnea ( $\text{RR} > 2$  SD of age), rectal temperature ( $>38$  °C or  $< 36$ °C),  $\text{PaCO}_2 < 32$  mmHg, leukocyte  $> 12000 / \text{mm}^3$  or  $< 4000 / \text{mm}^3$ .<sup>6</sup> PELOD score which used to know severity of disease according to physical examination and laboratory findings.<sup>9</sup> The PELOD scoring system consisted of physical and laboratory variables representing 6 organs, namely nervous, cardiovascular, renal, respiratory, hematologic, and hepatic system (Table 1). Multiple organ failure defined as the simultaneous occurrence of two organ dysfunctions. Change in organ function using criteria of: hypotension  $< 5^{\text{th}}$  percentile of age or systolic blood pressure  $< 2$  SD of age,  $\text{PaCO}_2 > 20$  mmHg, GCS  $< 11$ , thrombocyte count  $< 80000 / \text{mm}^3$ , creatinine serum  $> 2$  times from normal limit.<sup>6</sup> Nutrition status according to calculation of body weight and body height which plotted in CDC curve, the results were:<sup>10</sup>  $< 70\%$  defined as severe malnutrition, 70-90% defined as moderate malnutrition, 90-110%

defined as normal nutrition status, >110% defined as overweight, > 120% defined as obese. Severe malaria is acute or chronic infection disease which is signed by recurrent fever, shivering, headache, left hypochondria tenderness, nausea, vomit, malaise and hepatosplenomegaly. Diagnosis made by finding *Plasmodium* in blood smear, *Plasmodium falsiparum* ring positive 4 (hyperparasitemia > 5%).<sup>11</sup> Severe dehydration is loss of water more than input which signed by frequent vomit, diarrhea > 3 times / day, no urine output in last 6 hours, sunken eyes, no tears, dry of mouth mucosa, skin turgor return very slow, sunken fontanella.<sup>12</sup> Bronchopneumonia is acute inflammation of lung parenchyma, signed with fever, short of breath, nasal flare, cough, runny nose, rough of breath sound<sup>13</sup>. Acute diarrhea is watery defecation more than 3 times / day, with/or without blood, with/or without slime and lasting not more than 1 week.<sup>12</sup> Meningitis is inflammation at layer that surround brain and spinal cord, signed with fever, seizure, decreased of consciousness, headache, neurological deficit and meningeal sign.<sup>14</sup> Encephalitis is an infection of brain tissue which is signed with fever, seizure, decreased of consciousness after seizure resolve, neurological deficit and pathologic reflexes.<sup>14</sup> Decreased of consciousness defined as condition of consciousness which is lower than normal assessed by pediatric modification of Glasgow coma scale.<sup>14</sup>

## Analysis

Data was analyzed using descriptive analysis and correlative study. Descriptive analysis was used for analyzed characteristic data and report as distribution table. Correlative analysis was used for analyzed correlation between PELOD score and multiple organ failure. Data was processed using SPSS software for Windows version 17.

## Results

From 37 children, there were eight boys and three girls with multiple organ failure < 2. There were 14 (53.8%) girls and 12 (46.2%) boys with multiple organ failure > 2. Patient distribution can be seen in table 2. There was no significant difference in gender distribution, nutrition status and blood

culture between both of group. Children with organ failure less than two found mean age 46.1 months, standard deviation 47.7 months. Children with organ failure more than two found mean age 27.9 months, standard deviation 29.2 months. It founds 2 (5.4%) children with no organ failure. this study showed that there were two children who have 6 organ failures.

Patient's distribution according to organ failure and PELOD score can be seen in table 3.

Bronchopneumonia was the most common infection source (18 patients), followed by gastroenteritis (11 patients), encephalitis (6 patients) and meningitis (2 patients). From 16 children with positive blood culture, it founds 13 results (81.25%) of negative gram bacteria and 3 (18.75%) of positive gram bacteria. Twenty one children were found no bacterial growth in their blood culture. Kind of bacteria which is found was *Proteus mirabilis* (5 patients), *Citrobacter difersus* (5 patients), *Staphylococcus aureus* (3 patients), *Escherichia coli* (2 patients) and *Acinetobacter baumannii* (1 patient).

## Discussion

In this study, from 37 children, there were 20 (54.1%) boys. There was no significant different between both of gender. Watson<sup>16</sup> founds 1492 (54.8%) boys and 1232 (45.2%) girls. Proulx<sup>17</sup> in Canada founds 657 (62%) boys and 401 (38%) girls. It founds 26 (70.3%) children with multiple organ failure more than two and 11 (29.7%) children with multiple organ failure less than two. Saez<sup>3</sup> founds that there was 197 (24%) sepsis patients with MOD. Duke<sup>18</sup> reports 64% sepsis patient with MOD. Proulx<sup>17</sup> reports 145 (76%) sepsis patients with multiple organ failure, Thukral A, et al<sup>19</sup> in India founds 190 (90.9%) children with MOD more than two. Positive bacteria in blood culture or other body liquid like cerebral spinal fluid, bronchoalveolar secret, joint aspiration, peritoneum liquid is a gold standard.<sup>20</sup> In this study found 43.2% children with positive blood culture and 56.8% children with negative blood culture. The initial infection of sepsis was bronchopneumonia (18), gastroenteritis (11), encephalitis (6) and meningitis (2). That results quite same like study done by Xavier<sup>21</sup> i.e. bronchopneumonia 38%, gastroenteritis 18%, post

Table 1. PELOD Score

Organ dysfunction and variable	Scoring system			
	1	2	10	20
Nervous system				
Pediatric Glasgow Coma Scale	12-15 and both reaktive	7-11	4-6 or both fixed	3
Pupillary reaction				
Cardiovascular				
Heart rate (beats/min)				
< 12 years	≤ 195		>195	
≥ 12 years	≤ 150		>150	
Systolic blood pressure (mmHg)				
< 1 month	>65		35-65	<35
1 month – 1 year	>75		35-75	<35
1 – 12 years	>85		45-85	<45
≥ 12 years	>95		55-95	<55
Renal				
Creatinine (μmol/L)				
< 7 days	<140		≥ 140	
7 days – 1 year	<55		≥ 55	
1 – 12 years	<100		≥ 100	
≥ 12 years	<140		≥ 140	
Respiratory				
PaO2 (kPa)/FiO2 ratio	>9,3 and ≤ 11,7		≤ 9,3 or >11,7	
PaCO2 (kPa)				
Mechanical ventilation	No ventilation	Ventilation		
Hematologic				
White blood cell count (x 10 <sup>9</sup> /L)	≥ 4,5 and ≥ 35	1,5-4,4 or <35	<1,5	
Platelets (x 10 <sup>9</sup> /L)				
Hepatic				
Aspartate transaminase (IU/L)	<950 and >60 (1,40)	>950 or ≤ 60 (≥ 1,40)		
Prothrombin time (or INR)				

From: Leteurtre S. Validation of the Pediatric Logistic Organ Dysfunction Score. 15

Table 2. Patient distribution

	Organ failure <2 (n=11)	≥ 2 (n=26)	P
Sex			
Boys	8 (72.8%)	12 (46.2%)	0.138
Girls	3 (27.2%)	14 (53.8%)	
Age			
Mean (month)± SD	46.1 ± 47.7	27.9 ± 29.2	
CI 95%	14.0;78.2	16.1;39.7	
Nutritional status			
Moderate malnutrition	5 (45.5%)	14 (53.8%)	0.641
Normal nutrition	6 (54.5%)	12 (46.2%)	
Blood culture			
Negatif	5 (45.5%)	16 (61.5%)	0.294
Positif	6 (54.5%)	10 (38.5%)	
Pelod score			
0-10	8 (66.7%)	9 (36.0%)	
11-20	4 (33.3%)	7 (28.0%)	
21-30	0	8 (32.0%)	
31-40	0	1 (4%)	

operation 9%, meningitis 6%, urinary tract infection 5% and febrile with unknown origin 24%.

Multiple organ failure is systemic inflammation response that uncontrolled. Inflammation is an activation process of cooperation between circulated cells, endothelium and many pro inflammation mediators which in normal condition it balance with anti inflammation mediators. If pro inflammation mediators are dominant, it will lead to organ failure.<sup>22</sup> According to gender distribution, it founds 8 (72.8%) boys and 3 (27.2%) girls which has organ failure less than. In other condition, it founds 12 (46.2%) boys and 14 (53.8%) girls which has multiple organ failure more than. Proulx<sup>17</sup> in Canada founds 115 (68%) boys who have organ failure more than two. From 37 children founds 5 (45.5%) children in moderate malnutrition

Table 3. Patient's distribution according to organ failure and PELOD score

Organ failure	Total patient	Percentage	Standard deviation	Mean	(CI 95%)	Minimum	Maximum
0	2	5.4	0.0	1.0	(1.00;1.00)	1	1
1	9	24.3	5.1	5.3	(1.38;9.29)	1	11
2	8	21.6	8.8	8.3	(0.98;15.77)	1	22
3	8	21.6	9.7	12.3	(4.21;20.54)	1	22
4	7	18.9	7.2	14.1	(7.46;20.82)	2	21
5	1	2.7				12	12
6	2	5.4	0.7	30.5	(24.15;36.85)	30	31
Total	37	100.0	9.3	10.5	(7.38;13.59)	1	31

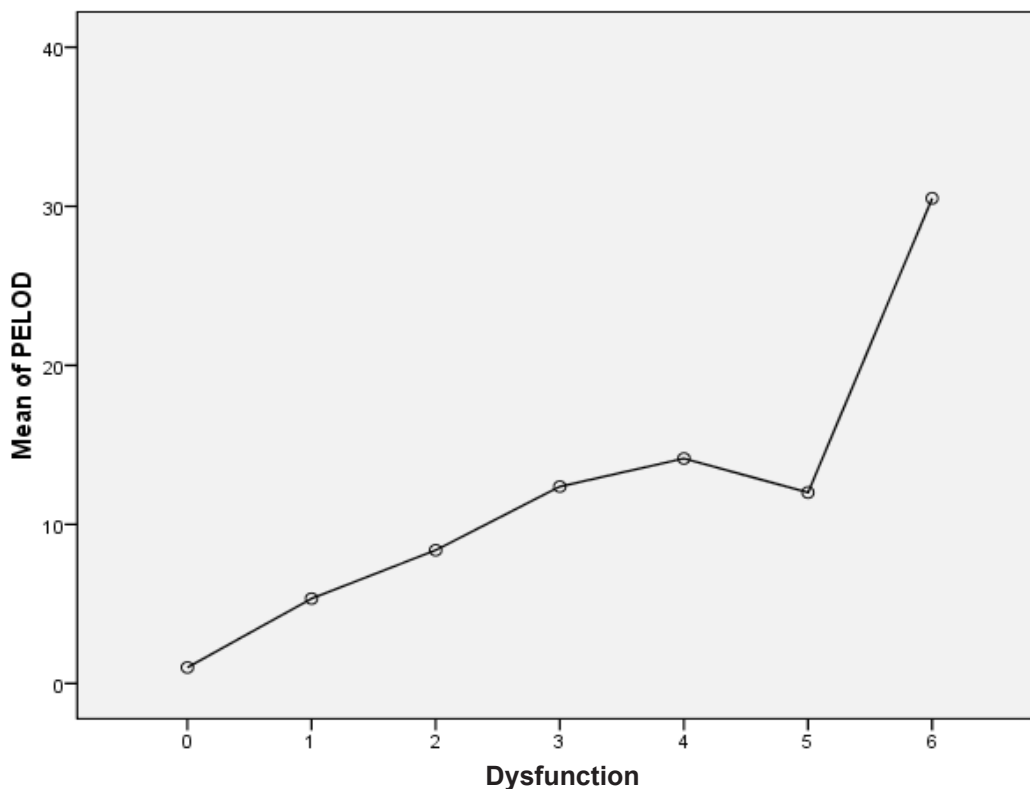


Figure 1. Correlation of PELOD score and multiple organ failure

with organ failure less than two and 6 (54.5%) children in good nutrition status with multiple organ failure less than two. It founds 12 (46.2%) children in good nutrition status with organ failure more than two and 14 (53.8%) children in moderate malnutrition with organ failure more than two. Literature said that child with sepsis and malnutrition which glycogen supply is limited, the fatty tissue was one of source. Child with sepsis is in hyper metabolism condition and increased catabolism, the source is protein remodeling, so child with severe illness and malnutrition is more like to be with organ failure.<sup>23</sup>

According to age distribution, founds mean age was 46.1 months for organ failure < 2 and mean age was 27.9 months for organ failure more than two. Proulx<sup>17</sup> in Canada founds mean age was 48.8 months for organ failure more than two. Leclerc F et al<sup>9</sup> in Canada also founds mean age was 24 months for organ failure more than two. From 37 children, founds that 11 children with organ failure less than two; 6 (54.5%) children has positive blood culture and 5 (45.5%) has negative blood culture. It founds 26 children with organ failure more than two; 10 (38.5%) children has positive blood culture and 16

(61.5%) has negative blood culture. Proulx<sup>17</sup> founds 26 (15%) children with organ failure more than two has positive blood culture.

Leclerc et al<sup>9</sup> develop PELOD score system for evaluate child who has critically ill at pediatric intensive care unit. PELOD evaluate six organ systems by seeing 12 clinical manifestation and laboratory finding. There was correlation between PELOD score and multiple organ failure, a higher PELOD score will lead to more severe of multiple organ failure that occurs. This study found 70.3% child who has multiple organ failure. Correlation between PELOD score and multiple organ failure can be shown by this equation:

$$P = 1 / (1 + e^{-2.56 - 0.137 \text{ PELOD}}), p = 0.02$$

The equation show that there was a significant correlation between PELOD score and multiple organ failure,  $P = 0.02$ . A higher PELOD score will increase opportunity a child having multiple organ failure. This condition was also found by Thukral A<sup>19</sup> in India; median for PELOD score was 7.8 with MOD more than two was 190 (90.9%). Leclerc F et al<sup>9</sup> report that child with organ failure was 965 (53%). From study in Hongkong founds median for PELOD score was 10 in 269 (45%) children with organ failure more than two. Leclerc F et al<sup>9</sup> founds median for PELOD score was 10 in 965 (54%) children with organ failure more than two. Our study found median for PELOD score was 8 in 26 (70.2%) children.

We conclude that there is a correlation between PELOD score and multiple organ failure in patient with sepsis. A higher PELOD score will increase opportunity a child having multiple organ failure.

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